

♦ **Social issues addressed at the protocol level.** Widespread use of the Internet has far-reaching effects on intellectual property rights, privacy protection, and data filtering. Exploring how these concerns might be addressed at the protocol level—through policies, rules, and conventions for the exchange and use of information—could be a promising approach to addressing issues arising from the use of new computer and communications technology. Examples include the Platform for Internet Content Selection (PICS)—which implements a set of protocols for rating Web sites—and P3P, a project for specifying privacy practices.

The NRC panel also identified ways to improve the data needed to study the economic and social effects of IT, such as making data related to the social and economic effects of computing and communications available to the research community through a clearinghouse; exploring ways for researchers to obtain access to private-sector data; and establishing stronger ties with industry associations to facilitate collaborative research.

Potential Information Technology Indices

Interconnectivity index. This index would provide a measure of the facility of electronic communication and an evaluation of the development of this dimension of the information infrastructure.

Information quality of life index. Similar to an index produced by OECD, this index would attempt to evaluate the qualitative levels of communication available to individuals.

Leading information indicators. This index would attempt to predict the growth of the information infrastructure.

Home media index. This index of the state of penetration of communications technologies in the home might qualify as a leading index of the potential for future consumption of information.

Marginalization index. This index would measure the extent to which specific populations are excluded from participation in the information infrastructure.

SOURCE: CSTB (1998).

Selected Bibliography

- Alberts, D.S., and D.S. Papp, eds. 1997. *The Information Age: An Anthology on Its Impact and Consequences*. Available at <<<http://www.ndu.edu/ndu/inss/books/anthology1/index.html>>>.
- Allen, T., and M.S. Morton, eds. 1994. *Information Technology and the Corporation of the 1990s*. New York: Oxford University Press.
- Alpar, P., and M. Kim. 1991. "A Microeconomic Approach to the Measurement of Information Technology Value." *Journal of Management Information Systems* 7, No. 2: 55–69.
- Association of Research Libraries (ARL). 1997. "ARL Announces Seventh Edition of the Directory of Electronic Journals, Newsletters and Academic Discussion Lists." Press release. Available at <<<http://www.arl.org/scomm/edir/pr97.html>>>.
- . 1999. "SPARC, the Scholarly Publishing & Academic Resources Coalition." Web page. Available at <<<http://www.arl.org/sparc/>>>. Accessed September 19, 1999.
- Atkinson, R.D., and R.H. Court. 1998. *The New Economy Index: Understanding America's Economic Transformation*. Washington, DC: Progressive Policy Institute.
- Attewell, P., and J. Rule. 1994. "Computing and Organizations: What We Know and What We Don't Know." In C. Huff and T. Finholt, eds., *Social Issues in Computing*. New York: McGraw-Hill.
- Autor, D., L. Katz, and A. Krueger. 1997. "Computing Inequality: Have Computers Changed the Labor Market?" NBER Working Paper No. 5956. Cambridge, MA: National Bureau of Economic Research.
- Baily, M.N., and A.K. Chakrabarti. 1988. *Innovation and the Productivity Crisis*. Washington, DC: Brookings Institution.
- Baker, E.L., M. Gearhart, and J.L. Herman. 1994. "Evaluating the Apple Classrooms of Tomorrow." In E.L. Baker and H.F. O'Neil, Jr. (eds.), *Technology Assessment in Education and Training*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Banker, R.D., and R.J. Kauffman. 1988. "Strategic Contributions of Information Technology: An Empirical Study of ATM Networks." In Proceedings of the Ninth International Conference on Information Systems, Minneapolis.
- Banker, R.D., R.J. Kauffman, and M.A. Mahmood. 1993. *Strategic Information Technology Management: Perspectives on Organizational Growth and Competitive Advantage*. Harrisburg, PA: Idea Group Publishing.
- Belman, D., K. Monaco, T. Brooks, and S. Burks. 1998. *The 1997 Survey of Truck Drivers: A Preliminary Report*. University of Michigan Trucking Industry Program. March.
- Berman, E., J. Bound, and Z. Griliches. 1994. "Changes in the Demand for Skilled Labor Within U.S. Manufacturing: Evidence From the Annual Survey of Manufacturers." *Quarterly Journal of Economics* May: 367–98.
- Biemiller, L. 1999. "California State U. Adopts New Model to Pay for Journals." *Chronicle of Higher Education* July 16: A26.

- Blumenstyk, G. 1999a. "Distance Learning at the Open University." *Chronicle of Higher Education* July 23: A35.
- . 1999b. "The Marketing Intensifies in Distance Learning." *Chronicle of Higher Education* April 9: A27.
- Bradley, S.P., J.A. Hausman, and R.L. Nolan. 1993. *Globalization, Technology, and Competition: The Fusion of Computers and Telecommunications in the 1990s*. Boston: Harvard Business School Press.
- Bresnahan, T. 1986. "Measuring the Spillovers From Technical Advance: Mainframe Computers in Financial Services." *American Economic Review* 76, No. 4: 742–55.
- . 1997. "Computerization and Wage Dispersion: An Analytical Reinterpretation." Paper prepared for the National Bureau of Economic Research, Summer Institute. August. Cambridge, MA: National Bureau of Economic Research.
- Brynjolfsson, E. 1993. "The Productivity Paradox of Information Technology: Review and Assessment." *Communications of the ACM*. December. Available at <<<http://ccs.mit.edu/CCSWP130/CCSWP130.html>>>.
- Brynjolfsson, E., and L. Hitt. 1995. "Information Technology as a Factor of Production: The Role of Differences Among Firms." *Economics of Innovation and New Technology* 3: 193–200.
- . 1996. "Paradox Lost? Firm-Level Evidence on the Returns to Information Systems Spending." *Management Science* 42, No 4: 541–58.
- . 1998. "Beyond the Productivity Paradox." *Communications of the ACM*. August. Available at <<<http://ccs.mit.edu/erik/bpp.pdf>>>.
- Brynjolfsson, E., and S. Yang. 1996. "Information Technology and Productivity: A Review of the Literature." *Advances in Computers* 43: 179–214.
- Bush, V. 1945. "As We May Think." *Atlantic Monthly*. Available at <<<http://www.theatlantic.com/unbound/flashbks/computer/bushf.htm>>>. Accessed August 4, 1999.
- Byrne, N. 1996. "Finance's Info-Tech Revolution-Special Report." *Business Week* October 28: 129–38.
- Campus Computing Project. 1998. 1998 National Survey of Information Technology in Higher Education. Available at <<<http://www.campuscomputing.net/>>>.
- Caron, A.H., L. Giroux, and S. Douzou. 1989. "Uses and Impacts of Home Computers in Canada: A Process of Reappropriation." In J. Salvaggio, J. Bryant, et al., eds. *Media Use in the Information Age: Emerging Patterns of Adoption and Consumer Use*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Castells, M. 1996. *The Rise of the Network Society*. Cambridge, MA: Basil Blackwell.
- Center for Research in Electronic Commerce. 1999. *Internet Economy Indicators*. Available at <<<http://www.internetindicators.com>>>. Accessed August 29, 1999.
- Cerf, V.G. 1997. "Computer Networking: Global Infrastructure for the 21st Century." In Computing Research Association, *Computing Research: Driving Information Technology and the Information Industry Forward*. Available at <<<http://www.cs.washington.edu/homes/lazowska/cra/>>>.
- Childers, Thomas. 1975. *The Information-Poor in America*. Metuchen, NJ: Scarecrow Press.
- Children's Partnership. 1996. *Where We Stand: May 1996*. Update to *America's Children and the Information Superhighway*. Available at <<<http://www.childrenspartnership.org/americaschild/stand.html>>>.
- Clemente, P.C. 1998. *State of the Net: The New Frontier*. New York: McGraw-Hill.
- Committee on Issues in the Transborder Flow of Scientific Data, National Research Council. 1997. *Bits of Power: Issues in Global Access to Scientific Data*. Washington, DC: National Academy Press.
- Computer Science and Telecommunications Board (CSTB). 1993. *National Collaboratories: Applying Information Technology for Scientific Research*. Washington, DC: National Academy Press.
- . 1994a. *Information Technology in the Service Society*. Washington, DC: National Academy Press.
- . 1994b. *Realizing the Information Future: The Internet and Beyond*. Washington, DC: National Academy Press.
- . 1997. *More Than Screen Deep: Toward Every-Citizen Interfaces to the Nation's Information Infrastructure*. Washington, DC: National Academy Press.
- . 1998. *Fostering Research on the Economic and Social Impacts of Information Technology*. Washington, DC: National Academy Press.
- . 1999. *Funding a Revolution: Computer Support for Computing Research*. Washington, DC: National Academy Press. Available at <<<http://bob.nap.edu/readingroom/far/contents.html>>>.
- Costa, A., and R. Liebmann, eds. 1997. *Supporting the Spirit of Learning: When Process Is Content*. Thousand Oaks, CA: Corwin Press.
- Cron, W.L., and M.G. Sobol. 1983. "The Relationship Between Computerization and Performance: A Strategy for Maximizing the Benefits of Computerization." *Information and Management* 6: 171–81.
- Cuban, L. 1994. "The Promise of the Computer." In C. Huff and T. Finholt, eds., *Social Issues in Computing*. New York: McGraw-Hill.
- Curley, K., and P. Pyburn. 1982. "Intellectual Technologies: The Key to Improving White-Collar Productivity." *Sloan Management Review* Fall: 31–39.
- Cyert, R., and D. Mowery, eds. 1987. *Technology and Employment: Innovation and Growth in the US Economy*. Washington, DC: National Academy Press.
- Danziger, J.N., and K.L. Kraemer. 1986. *People and Computers: The Impacts of Computing on End Users in Organizations*. New York: Columbia University Press.
- David, P.A. 1989. *Computer and Dynamo: The Modern Productivity Paradox in a Not-Too-Distant Mirror*. Stanford, CA: Stanford University, Center for Economic Policy Research.

- Department of Energy/National Science Foundation (DOE/NSF). 1998. National Workshop on Advanced Scientific Computing. July 30–31.
- Dickerson, M.D., and J.W. Gentry. 1983. "Characteristics of Adopters and Non-Adopters of Home Computers." *Journal of Consumer Research* 10: 225–35.
- Distance Education and Training Council. 1999. *What is the DETC?* Available at <<<http://www.detc.org/>>>. Accessed August 23, 1999.
- Dutton, W.H., E.M. Rogers, and S-H Jun. 1987. "The Diffusion and Impacts of Information Technology in Households." In P.I. Zorkoczy, ed., *Oxford Surveys in Information Technology*, Vol. 4. Oxford: Oxford University Press.
- Educational Testing Service (ETS). 1997. *Computers and Classrooms: The Status of Technology in U.S. Schools*, Policy Information Report. Princeton, NJ: Educational Testing Service, Policy Information Center.
- Egger, O., and M. Rauterberg. 1996. "Internet Behaviour and Addiction" Web page. Available at <<<http://www.ifap.bepr.ethz.ch/~egger/ibq/res.htm>>>. Accessed April 12, 1999.
- Forester, T. 1989. *Computers in the Human Context: Information Technology, Productivity, and People*. Cambridge, MA: MIT Press.
- Forrester Research. 1998. "U.S. On-line Business Trade Will Soar To \$1.3 Trillion By 2003, According To Forrester Research." News release. Available at <<<http://www.forrester.com>>>. Accessed August 29, 1999.
- . 1999. "Online Retail To Reach \$184 Billion By 2004 As Post-Web Retail Era Unfolds." News release. September 28. Available at <<<http://www.forrester.com/ER/Press/Release/0,1769,164,FF.html>>>.
- Franke, R.H. 1989. "Technological Revolutions and Productivity Decline: The Case of U.S. Banks." In T. Forester, ed., *Computers in the Human Context: Information Technology, Productivity, and People*. Cambridge, MA: MIT Press.
- Freeman, C., L. Soete, and U. Efendioglu. 1995. "Diffusion and the Employment Effects of Information and Communication Technology." *International Labor Review* 134, Nos. 4–5: 587–603.
- Freeman, P., and W. Aspray. 1999. *The Supply of Information Technology Workers in the United States*. Washington, DC: Computing Research Association.
- Friedlander, A. 1997. *Infrastructure: The Utility of Past as Prologue*. Reston, VA: Corporation for National Research Initiatives.
- Getz, M. 1997. "Electronic Publishing in Academia: An Economic Perspective." Paper presented at Scholarly Communication and Technology Conference, Emory University, Atlanta. April 24–25. Available at <<<http://arl.cni.org/scomm/scat/getz.html>>>. Accessed August 18, 1999.
- Giacquinta, J.B., J. Bauer, and J.E. Levin. 1993. *Beyond Technology's Promise: An Examination of Children's Educational Computing at Home*. Cambridge: Cambridge University Press.
- Gomery, R.E. 1994. "A Ricardo Model with Economies of Scale." *Journal of Economic Theory* 62 (April): 394–419.
- Graham, J. 1976. *Making Computers Pay*. New York: John Wiley and Sons.
- Greenspan, A. 1999. "High-Tech Industry in the U.S. Economy." Testimony before Joint Economic Committee, United States Congress. June 14. Available at <<<http://www.federalreserve.gov/boarddocs/testimony/1999/19990614.htm>>>.
- Griliches, Z. 1997. "Comment on Sichel." *Review of Economics and Statistics* August: 371.
- Guernsey, L. 1998. "Distance Education for the Not-So-Distant." *Chronicle of Higher Education* March 27: A29.
- Gurstein, P. 1991. "Working at Home and Living at Home: Emerging Scenarios." *Journal of Architectural and Planning Research* 8, No. 2: 164–80.
- Habib, L., and T. Cornford. 1996. "The Virtual Office and Family Life." In *SIGCPR/SIGMIS '96: Proceedings of the 1996 Annual Meetings of the Association for Computing Machinery Special Interest Group on Computer Personnel Research/Special Interest Group on Management Information Systems*. Denver, CO: Association for Computing Machinery.
- Harel, I., ed. 1990. *Constructionist Learning: A 5th Anniversary Collection of Papers Reflecting Research Reports, Projects in Progress, and Essays by the Epistemology and Learning Group*. Cambridge, MA: MIT Media Laboratory.
- Harel, I., and S. Papert. 1991. "Software Design as a Learning Environment." In I. Harel and S. Papert (eds.), *Constructionism*. Norwood, NJ: Ablex.
- Hoffman, D., and T. Novak. 1998. "Bridging the Digital Divide: The Impact of Race on Computer Access and Internet Use." Web page. Available at <<<http://www.2000.ogsm.vanderbilt.edu/papers/race/science.html>>>. Accessed April 12, 1999.
- Howell, D., and E. Wolff. 1993. *Changes in the Information-Intensity of the U.S. Workplace Since 1950: Has Information Technology Made a Difference?* Monograph R.R. #93-08. New York: New York University, C.V. Starr Center for Applied Economics.
- Huff, C., and T. Finholt, eds. 1994. *Social Issues in Computing*. New York: McGraw-Hill.
- International Data Corporation (IDC). 1999. "Internet Commerce Will Rocket to More Than \$1 Trillion by 2003." Press release. Available at <<<http://www.idc.com/Press/default.htm>>>. Accessed August 29, 1999.
- Johnson, G.E., and F.P. Stafford. 1998. "Technology Regimes and the Distribution of Real Wages." In Eliasson, G., and C. Green (eds.), *Microfoundations of Economic Growth: A Schumpeterian Perspective*. Ann Arbor, MI: University of Michigan Press.
- Johnson, S.T., and J.A. Bobo. 1998. *Software Workers for the New Millennium: Global Competitiveness Hangs in the Balance*. Arlington, VA: National Software Alliance. Available at <<<http://www.software-alliance.org>>>.

- JSTOR. 1999. "About JSTOR." Available at <<<http://www.jstor.org/about/>>>. Accessed August 24, 1999.
- Kahin, B., and C. Nesson. 1997. *Borders in Cyberspace*. Cambridge, MA: MIT Press.
- Katz, J.E., and P. Aspden. 1997. "A Nation of Strangers?" *Communications of the ACM* 40, No. 12: 81–86.
- Katz, L.F. 1999. "Technological Change, Computerization, and the Wage Structure." Paper prepared for conference on "Understanding the Digital Economy: Data, Tools, and Research," U.S. Department of Commerce, Washington, DC. May 25–26. Available at <<<http://mitpress.edu/UDE/katz.rft>>>.
- Kearsley, G. 1997. *A Guide to Online Education*. Available at <<<http://gwis.circ.gwu.edu/~etl/online.html>>>.
- Kearsley, G., W. Lynch, and D. Wizer. 1995. "Effectiveness and Impact of Computer Conferencing in Graduate Education." Available at <<<http://gwis.circ.gwu.edu/~etl/cmc.html>>>.
- Khosrowpour, M. 1994. *Information Technology and Organizations: Challenges of New Technologies*. Harrisburg, PA: Idea Group Publishing.
- Kiernan, V. 1999. "Why Do Some Electronic Only Journals Struggle, While Others Flourish?" *Chronicle of Higher Education* May 21: A25.
- Kling, R., and R. Lamb. 1999. "IT and Organizational Change in Digital Economies: A Socio-Technical Approach." Paper prepared for conference on "Understanding the Digital Economy: Data, Tools and Research," U.S. Department of Commerce, Washington DC. May 25–26. Available at <<<http://mitpress.mit.edu/ude.html>>>.
- Kranzberg, M. 1989. "IT as Revolution." In T. Forester, ed., *Computers in the Human Context: Information Technology, Productivity, and People*. Cambridge, MA: MIT Press.
- Kraut, R., V. Lundmark, M. Patterson, S. Kiesler, T. Mukhopadhyay, and W. Scherlis. 1998. "Internet Paradox: A Social Technology That Reduces Social Involvement and Psychological Well-Being?" *American Psychologist* 53, No. 9: 1017–31.
- Kraut, R., T. Mukhopadhyay, J. Szczypula, S. Kiesler, and W. Scherlis. 1998. "Communication and Information: Alternative Uses of the Internet in Households." In *CHI '98: Proceedings of the 1998 Conference on Human Factors in Computing Systems*, Association for Computing Machinery Special Interest Group on Computer-Human Interaction. Los Angeles: Association for Computing Machinery.
- Kraut, R., W. Scherlis, T. Mukhopadhyay, J. Manning, and S. Kiesler. 1996. "The HomeNet Field Trial of Residential Internet Services." *Communications of the ACM* 39, No. 12: 55–63.
- Kulik, C.L., and J.A. Kulik. 1991. "Effectiveness of Computer-Based Instruction: An Updated Analysis." *Computers in Human Behavior* 7: 75–94.
- Kulik, J.A. 1994. "Meta-Analytic Studies of Findings on Computer-Based Instruction." In E.L. Baker and H.F. O'Neil, Jr. (eds.), *Technology Assessment in Education and Training*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Landauer, T.K. 1995. *The Trouble With Computers: Usefulness, Usability, and Productivity*. Cambridge, MA: MIT Press.
- Lawrence, S., and L. Giles. 1999. "Accessibility of Information on the Web." *Nature* 400 (July 8): 107–109.
- Leiner, B., M. Vinton, G. Cerf, D.D. Clark, R.E. Kahn, L. Kleinrock, D.C. Lynch, J. Postel, L.G. Roberts, and S. Wolff. 1998. "A Brief History of the Internet." Available at <<<http://www.isoc.org/internet/history/brief.html>>>.
- Lerman, R.I. 1998. "Emerging Trends in the Information Technology Job Market: How Should the Public and Private Sectors Respond?" Testimony before Subcommittee on Oversight and Investigations Committee on Education and the Workforce, U.S. House of Representatives. April 23. Available at <<<http://www.urban.org/TESTIMON/lerman4-23-98.html>>>.
- Lesk, M. 1997a. "How Much Information Is There In the World?" Available at <<<http://www.lesk.com/mlesk/ksg97/ksg.html>>>. Accessed August 5, 1999.
- . 1997b. *Practical Digital Libraries: Books, Bytes, and Bucks*. San Francisco: Morgan Kaufman.
- Library of Congress. 1999. Fascinating Facts About the Library of Congress. Available at <<<http://www.loc.gov/today/fascinate.html#STATS>>>. Accessed August 18, 1999.
- Lichtenberg, F.R. 1995. "The Output Contributions of Computer Equipment and Personnel: A Firm-Level Analysis." *Economics of Innovation and New Technology* 3: 201–17.
- Link, A.N., and J.T. Scott. 1998. "Assessing the Infra-structural Needs of a Technology-Based Service Sector: A New Approach to Technology Policy Planning." *STI Review* 22 (August).
- Lyman, P., ed. 1996. "Books, Bricks, & Bytes." Special Symposium on the Changing Role of Libraries. *Daedalus* (Fall).
- Machlup, F. 1962. *The Production and Distribution of Knowledge in the United States*. Princeton, NJ: Princeton University Press.
- Machovec, G. 1997. *Electronic Journal Overview—1997*. Denver, CO: Alliance of Research Libraries. Available at <<<http://www.coalliance.org/reports/ejournal.htm>>>.
- Mann, D., C. Shakeshaft, J. Becker, and R. Kottkamp. 1999. *West Virginia's Basic Skills/Computer Education Program: An Analysis of Student Achievement*. Santa Monica, CA: Milken Family Foundation.
- Mark, J. 1982. "Measuring Productivity in Service Industries." *Monthly Labor Review* June: 3–8.
- Marshall, E. 1999. "E-biomed Morphs to E-biosci," Focus Shifts to Reviewed Papers." *Science* 285 (August 6): 810–11.
- McKinsey and Company. 1995. "Connecting K-12 Schools to the Information Superhighway." Report prepared for U.S. Advisory Council on the National Information Infrastructure. Available at <<<http://cavern.uark.edu/mckinsey/>>>.
- McQuarrie, E.F. 1989. "The Impact of A Discontinuous Innovation: Outcomes Experienced by Owners of Home Computers." *Computers in Human Behavior* 5: 227–40.
- Miller, G.E. n.d. "An Interview with Frank Mayadas of the Alfred P. Sloan Foundation." *American Journal of Distance*

- Education* 11, No. 3. Available at <<http://www.aln.org/alnweb/mayadas_miller.htm>>.
- Mogge, D. 1999. "Seven Years of Tracking Electronic Publishing: The ARL Directory of Electronic Journals, Newsletters, and Academic Discussion Lists." *Library Hi Tech* 17, No.1: 17–25.
- Monaghan, P. 1998. "U. of Washington Professors Decry Governor's Visions for Technology." *Chronicle of Higher Education* June 19: A23.
- Moore, G. 1999. "Gordon Moore on Moore's Law." Web page. Available at <<<http://developer.intel.com/solutions/archive/issue2/feature.htm>>>. Accessed August 20, 1999.
- Morisi, T.L. 1996. "Commercial Banking Transformed by Computer Technology." *Monthly Labor Review* August: 30–36.
- Morris, K. 1999. "Wiring the Ivory Tower." *Business Week*. (August 9): 90–92.
- Moye, W.T. 1996. "ENIAC: The Army-Sponsored Revolution." *ARL Historian*. Available at <<<http://ftp.arl.mil/~mike/comphist/96summary/>>>. Accessed August 4, 1999.
- Nagarajan, A., J.L. Bander, C.C. White. 1999. "Trucking." In Board on Science, Technology, and Economic Policy, National Research Council, *U.S. Industry in 2000: Studies in Competitive Performance*. Washington, DC: National Academy Press.
- National Automated Clearing House Association. 1999. "Electronic Payments in 1998 Surpass 5.3 Billion, Up 17.5% Over Year Ago." Press release. April 12. Available at <<<http://www.nacha.org/whats-hot/press/1999/98achvol.htm>>>. Accessed September 16, 1999.
- National Center for Education Statistics (NCES). 1999. *Internet Access in Public Schools and Classrooms: 1994–98*. Washington, DC: U.S. Department of Education. Available at <<<http://www.ed.gov/NCES/pubs99/1999017.pdf>>>.
- . 1999b. *Distance Education at Postsecondary Education Institutions: 1997–98*. Washington, DC: U.S. Department of Education (NCES 200-013).
- National Information Infrastructure Advisory Council (NIIAC). 1995. *A Nation of Opportunity: A Final Report of the United States Advisory Council on the National Information Infrastructure*. Available at <<<http://www.ed.psu.edu/~ae-insys-wfed/INSYS/ESD/tech/Highway/nation.home.html>>>.
- National Science and Technology Council (NSTC), Subcommittee on Computing, Information, and Communications R&D, Committee on Technology. 1999. *High Performance Computing and Communications: Information Technology Frontiers for a New Millennium*. Available at <<<http://www.ccic.gov/pubs/blue00/>>>.
- National Telecommunications and Information Administration (NTIA). 1995. "Falling Through the Net: A Survey of the 'Have Nots' in Rural and Urban America." Available at <<<http://www.ntia.doc.gov/ntiahome/fallingthru.html>>>; associated data tables available at <<<http://www.ntia.doc.gov/ntiahome/tables.htm>>>.
- . 1998. "Falling Through the Net II: New Data on the Digital Divide" Web page. Available at <<<http://www.ntia.doc.gov/ntiahome/net2/falling.html>>>. Accessed April 12, 1999.
- . 1999. "Falling Through the Net: Defining the Digital Divide" Web page. Available at <<<http://www.ntia.doc.gov/ntiahome/digitaldivide/>>>. Accessed July 15, 1999.
- Noble, D.F. 1998. "Digital Diploma Mills: The Automation of Higher Education." *First Monday* 3, No.1. Available at <<http://www.firstmonday.dk/issues/issue3_1/noble/index.html#author>>.
- Noyelle, T., ed. 1990. *Skills, Wages, and Productivity in the Service Sector*. Boulder, CO: Westview Press.
- Odlyzko, A. 1997. "The Economics of Internet Journals." *First Monday* 2, No. 8. Available at <<http://www.firstmonday.dk/issues/issue2_8/odlyzko/index.html>>.
- Office of Technology Assessment (OTA). 1995. *Teachers and Technology: Making the Connection*. Washington, DC: U.S. Government Printing Office.
- Office of Technology Policy. 1997. *America's New Deficit: The Shortage of Information Technology Workers*. Washington, DC: U.S. Department of Commerce.
- . 1998. *Update: America's New Deficit*. Washington, DC: U.S. Department of Commerce. January.
- Ogburn, W.F. 1964. *On Culture and Social Change: Selected Papers*. O.D. Duncan, ed. Chicago: University of Chicago Press.
- Oliner, S.D., and D. Sichel. 1994. "Computers and Output Growth Revisited: How Big Is the Puzzle?" *Brookings Papers on Economic Activity* No. 2: 273–315.
- Olson, F. 1999. "Virtual Institutions Challenge Accreditors to Devise New Ways of Measuring Quality." *Chronicle of Higher Education* August 6: A29.
- Online Computer Library Center (OCLC). 1999. June Web Statistics. Available at <<<http://www.oclc.org/oclc/research/projects/webstats/statistics.htm>>>.
- Oppenheimer, T. 1997. "The Computer Delusion." *Atlantic Monthly* July: 45–56.
- Organisation for Economic Co-operation and Development (OECD). 1998. *Information Technology Outlook 1997*. Paris: OECD.
- . 1999a. *Communications Outlook 1999*. Paris: OECD.
- . 1999b. *The Economic and Social Impact of Electronic Commerce*. Paris: OECD.
- . 1999c. *The Knowledge-Based Economy: A Set of Facts and Figures*. Meeting of the Committee for Scientific and Technological Policy at Ministerial Level. June 22–23. Paris: OECD.
- Papert, S. 1995. "Technology in Schools: Local Fix or Global Transformation?" Testimony for a U.S. House of Representatives Panel on Technology and Education. October 12. Available at <<<http://kids.www.media.mit.edu/projects/kids/sp-talk.html>>>.
- Pelgrum, W.J., R. Janssen, and T. Plomp, eds. 1993. *Schools,*

- Teachers, Students, and Computers: A Cross-National Perspective*. International Association for the Evaluation of Educational Achievement. Available at <<<http://uttou2.to.utwente.nl/comped/fr2/contents.htm>>>.
- Perez, C. 1983. "Structural Change and Assimilation of New Technologies in the Economic and Social System." *Futures* 15, No. 5: 357–75.
- Plafker, T. 1998. "Via E-Mail, Expatriate Chinese Professor Sends Uncensored News Back Home." *Chronicle of Higher Education* December 4.
- Porter, M., and V. Millar. 1985. "How Information Gives You Competitive Advantage." *Harvard Business Review* July-August: 149–60.
- President's Committee of Advisors on Science and Technology (PCAST), Panel on Educational Technology. 1997. Report to the President on the Use of Technology to Strengthen K–12 Education in the United States. Available at <<<http://www1.whitehouse.gov/WH/EOP/OSTP/NSTC/PCAST/k-12ed.html>>>.
- Regalado, A. 1999. "Mining the Genome." *Technology Review* 102, No. 5 (September-October): 56–63.
- Riccobono, J.A. 1986. *Use of Electronic Information Technologies for Non-School Learning in American Households: Report of Findings From the 1985 Home Information Technology Study (HITS)*. CS-86-215. Washington, DC: U.S. Department of Education, Center for Statistics.
- Riley, F., and D.W. McCloskey. 1996. "GTE's Experience With Telecommuting: Helping People Balance Work and Family." In *SIGCPR/SIGMIS '96: Proceedings of the 1996 Annual Meetings of the Association for Computing Machinery Special Interest Group on Computer Personnel Research/Special Interest Group on Management Information Systems*. Denver, CO: Association for Computing Machinery.
- Robinson, J.P., K. Barth, and A. Kohut. 1997. "Social Impact Research: Personal Computers, Mass Media, and Use of Time." *Social Science Computer Review* 15, No. 1: 65–82.
- Rosenberg, R. 1997. *The Social Impact of Computers*. 2nd ed. San Diego: Academic Press.
- Ross-Flanigan, N. 1998. "The Virtues (and Vices) of Virtual Colleagues." *Technology Review* March/April. Available at <<<http://www.techreview.com/articles/ma98/ross-flanigan.html>>>.
- Rowe, S.A. 1994. "Management Involvement: A Key Element in Preventing Musculoskeletal Problems in Visual Display Unit Users in Australia." In C. Huff and T. Finholt, eds., *Social Issues in Computing*. New York: McGraw-Hill.
- Rubin, A. 1996. "Educational Technology: Support for Inquiry-Based Learning." In *Technology Infusion and School Change: Perspectives and Practices*. Model Schools Partnership Research Monograph. Cambridge, MA: TERC.
- Ryan, A. 1991. "Meta-Analysis of Achievement Effects of Microcomputer Applications in Elementary Schools." *Educational Administration Quarterly* 27, No. 2 (May): 161–84.
- Scardamalia, M., and C. Bereiter. 1996. "Computer Support for Knowledge-Building Communities." In T. Koschmann, ed., *CSCS: Theory and Practice of an Emerging Paradigm*. Mahwah, NJ: Erlbaum.
- Schacter, J. 1999. *The Impact of Education Technology on Student Achievement: What the Most Current Research Has to Say*. Santa Monica, CA: Milken Exchange on Education Technology. Available at <<<http://www.milkenexchange.org>>>.
- Schneider, A. 1999. "AAUP Seeks Greater Faculty Role in Distance-Learning Decisions." *Chronicle of Higher Education* June 25: A34.
- Schofield, J.W. 1995. *Computers and Classroom Culture*. Cambridge, UK: Cambridge University Press.
- Schutte, G. 1997. "Virtual Teaching in Higher Education: The New Intellectual Superhighway or Just Another Traffic Jam?" Available at <<<http://www.csun.edu/sociology/virexp.htm>>>.
- Science. 1996. "Computers in Biology." Special issue on the role of computers in biological research and knowledge accumulation. Vol. 273 (August 2): 585–607.
- Semiconductor Industry Association (SIA). 1998. *International Technology Roadmap For Semiconductors: 1998 Update*. Available at <<<http://www.itrs.net/ntrs/publntrs.nsf>>>.
- Sichel, D. 1997. *The Computer Revolution: An Economic Perspective*. Washington, DC: Brookings Institution.
- Sivin-Kachala, J. 1998. *Report on the Effectiveness of Technology in Schools, 1990–1997*. Software Publishers Association.
- Solow, R. 1957. "Technological Change and the Aggregate Production Function." *Review of Economics and Statistics* 39 (August): 312–20.
- . 1987. "We'd Better Watch Out." *New York Times Book Review* July 12: 36.
- Steinfeld, C.W., W.H. Dutton, and P. Kovaric. 1989. "A Framework and Agenda for Research on Computing in the Home." In J.L. Salvaggio and J. Bryant (eds.), *Media Use in the Information Age: Emerging Patterns of Adoption and Consumer Use*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Stoll, C. 1995. *Silicon Snake Oil: Second Thoughts on the Information Highway*. New York: Doubleday.
- Tapscott, D. 1996. *The Digital Economy: Promise and Peril in the Age of Networked Intelligence*. New York: McGraw-Hill.
- Thurow, L. 1987. "Economic Paradigms and Slow American Productivity Growth." *Eastern Economic Journal* 13: 333–43.
- Turkle, S. 1984. *The Second Self: Computers and the Human Spirit*. New York: Simon and Schuster.
- . 1995. *Life on the Screen: Identity in the Age of the Internet*. New York: Simon and Schuster.
- U.S. Department of Commerce. 1997. *America's New Deficit: The Shortage of Information Technology Workers*. Washington, DC: U.S. Department of Commerce.
- . 1999a. *The Emerging Digital Economy II*. Washing-

- ton, DC: U.S. Department of Commerce. Available at <<<http://www.ecommerce.gov>>>.
- . 1999b. *The Digital Work Force: Building Infotech Skills at the Speed of Innovation*. C.A. Meares and J.F. Sargent, principal authors. Washington, DC: U.S. Department of Commerce. Available at <<<http://www.ta.doc.gov/reports/itsw/Digital.pdf>>>.
- U.S. Copyright Office, Library of Congress. 1999. *Report on Copyright and Digital Distance Education*. Report of the Register of Copyrights.
- Varmus, H. 1998. "New Directions in Biology and Medicine." Plenary Lecture at annual meeting of American Association for the Advancement of Science. Philadelphia. February 13. Available at <<<http://www.nih.gov/welcome/director/021398.htm>>>.
- . 1999. "Fiscal Year 2000 President's Budget Request for the National Institutes of Health." Statement before House and Senate Appropriations Subcommittees on Labor, Health and Human Services, and Education. February 23–24. Available at <<<http://www.nih.gov/welcome/director/022299.htm>>>.
- Vitalari, N.P., A. Venkatesh, and K. Gronhaug. 1985. "Computing in the Home: Shifts in the Time Allocation Patterns of Households." *Communications of the ACM* 28, No. 5: 512–22.
- Webster, F. 1997. "What Information Society?" In D.S. Alberts and D.S. Papp, eds., *The Information Age: An Anthology on Its Impact and Consequences*. Available at <<<http://www.ndu.edu/ndu/inss/books/Anthology1/part1.html>>>.
- Wenglinsky, H. 1998. *Does It Compute? The Relationship Between Educational Technology and Student Achievement in Mathematics*. Educational Testing Service Policy Information Center.
- World Information Technology and Services Alliance (WITSA). 1999. *Digital Planet: The Global Information Economy*. Arlington, VA: WITSA.
- Young, J.R. 1998. "600 Colleges and Universities to Gain Access to a Huge Data Base." *Chronicle of Higher Education* July 3: A20.